Supraventricular Arrhythmias

Reading Assignment

Chapter 5
(p.17-30)
# The Supraventricular Rhythms In Our Lives

## Site of Origin
- **Sinus**
- **Atrial**
- **Junctional (AVN, His)**
- **Ventricular**

## Single Events
- Sinus bradycardia
- PAC’s
- J-escape beats
- PVC’s

## Slow Rates
- Normal sinus rhythm
- Ectopic atrial rhythm
- J-escape rhythm (~40-50 bpm)
- V-escape rhythm (~35-45 bpm)

## Intermediate Rates
- Atrial fibrillation
- Atrial flutter (4:1 block)
- Accelerated J- rhythm (~55-100 bpm)
- Accelerated V- rhythm (~50-100 bpm)

## Fast Rates (>100 bpm)
- Sinus tachycardia
- Paroxysmal SVT
- Atrial fibrillation
- Atrial flutter (e.g., 2:1 block)
- Multifocal atrial tachycardia
- Junctional tachycardia
- Paroxysmal SVT: -AVNRT
  -AVRT (WPW)
- Ventricular tachycardia
- Torsade de points
- Ventricular fibrillation
Welcome to the “5-Step Method”

<table>
<thead>
<tr>
<th>Measurement:</th>
<th>Rhythm (s):</th>
<th>Conduction:</th>
<th>Waveform:</th>
<th>Interpretation:</th>
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<tbody>
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<td>A=</td>
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<td>PR=</td>
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<td>QRS=</td>
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<td>QT=</td>
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<td>Axis=</td>
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1. Compute the 5 basic measurements: HR, PR interval, QRS duration, QT interval, Axis
2. What’s the basic rhythm and other rhythm statements (e.g., PACs and PVC’s)
3. Any conduction abnormalities (SA blocks, AV blocks (Types I or II), and IV blocks
4. Waveform abnormalities beginning with P waves, QRS complexes, ST-T, and U waves
5. Final interpretations: Normal ECG or Borderline or Abnormal ECG (list final conclusions)
62 year old man
### Measurements:

<table>
<thead>
<tr>
<th>A = 300</th>
<th>V = 150</th>
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<table>
<thead>
<tr>
<th>PR = ?</th>
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<tbody>
<tr>
<td>QRS = 80</td>
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<tr>
<td>QT = ?</td>
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<td>Axis = +45</td>
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### Rhythm (s): Conduction: Waveform: Interpretation:

| Atrial flutter | Mostly 2:1 AV conduction | Flutter waves (arrows) are hidden in the T and after the QRS; normal QRS, low amplitude T waves | Abnormal ECG: 1. Rhythm 2. Nonspecific T wave abnormalities |

**Note:** In every regular SVT @ ~150 bpm, always put atrial flutter with 2:1 block first on the list of differential diagnoses! Look carefully for flutter waves. They are not equally well seen in every lead.
72 year old woman; hospital day 3
Why was she admitted?
Imagine II, III, aVF with the disappearance of QRS complexes: what is left is a saw-tooth pattern of atrial flutter (best seen in the inferior leads).

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<tbody>
<tr>
<td>A=135 V=270</td>
<td>Atrial flutter</td>
<td>Mostly 2:1 AV conduction</td>
<td>flutter waves (saw-tooth)</td>
<td>Abnormal ECG:</td>
</tr>
<tr>
<td>PR=?</td>
<td>IVCD (QRS 110 ms)</td>
<td>Q's II, III, aVF (arrows) with questionable ST elevation (distorted by the flutter waves)</td>
<td>1. Rhythm and rate</td>
<td></td>
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<tr>
<td>QRS=110</td>
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<td>2. Inferior MI (age undertermined, possibly recent)</td>
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<td>QT=?</td>
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<td>3. Incomplete RBBB; note late rightward forces in I, aVL, V6</td>
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<td>Axis =~ 0</td>
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</tbody>
</table>
65 year old man with chest pain
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation: \\
---|---|---|---|---
A=135 V=270 | Atrial flutter and 3 PVCs | 2:1 AV conduction | • Flutter waves (best seen in lead II, but also seen in other leads (arrows))  
• Q’s II, III aVF  
• Prominent anterior forces (PAF); note R>S in V1-2 | Abnormal ECG:  
1. Rhythm (atrial flutter and few PVC’s)  
2. PAF and inferior Q waves: infero-posterior (or new terminology infero-lateral MI – age undetermined)
54 year old man admitted with HFrEF (EF 24%), elevated BNP
Atrial fibrillation

- Moderate heart rate response to A-fib
- Normal IV

- A-fib activity
- Huge voltage for LVH (V1-3)
- T wave inversion I, aVL, V5,6
- Poor R wave progression V1-4

Abnormal ECG:
1. Rhythm (A-fib)
2. LVH with strain pattern
81 year old man with hypertension; what are those two FLB’s?
### ECG Findings

**Measurements:**
- A=300
- V=75
- PR=7
- QRS=110
- QT=340
- Axis=-60

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</table>
| Atrial flutter | Mostly 4:1 and occasional 2:1 AV conduction with RBBB aberrant conduction (arrow) | • Flutter waves  
• rS II, III, aVF with SIII>SII  
• Small q in aVL  
• LVH voltage (V2) with ST-T strain pattern | Abnormal ECG:  
1. Rhythm (atrial flutter)  
2. Left anterior fascicular block (LAFB)  
3. LVH with strain |
SG: 62 year old man

Official Interpretation:

Atrial fibrillation with rapid ventricular response
ST & T wave abnormality, consider anterior ischemia
Abnormal ECG
**Measurements:**

- A=280
- V=140
- PR=?
- QRS=70
- QT= ~320
- Axis= +10

**Rhythm (s):**

- Atrial flutter

**Conduction:**

- Mostly 2:1 AV conduction (note: mostly fixed [constant] RR intervals – rules out A-fib)

**Waveform:**

- Flutter waves (blue arrows)
- T wave inversion V1-4
- Small Q's II, III, aVF
- Note presence of artifact in some of the leads (red arrows)

**Interpretation:**

- Abnormal ECG
  1. Rhythm (atrial flutter)
  2. Nonspecific T abnormality
  3. Possible old inferior MI
JS: 82 year old woman

Official Interpretation:

- Atrial flutter with variable A-V block
- Nonspecific ST and T wave abnormalities
- Abnormal ECG
**Measurements:**

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<th>Interpretation:</th>
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<tbody>
<tr>
<td>A= ?</td>
<td>V= 110</td>
<td>Atrial fibrillation</td>
<td>Rapid ventricular response (&gt;100 bpm)</td>
<td>Abnormal ECG:</td>
</tr>
<tr>
<td>PR= ?</td>
<td></td>
<td></td>
<td>• A-fib activity (best seen in V1 lead, not classic flutter waves)</td>
<td>1. Rhythm (A-fib) and rate</td>
</tr>
<tr>
<td>QRS=70</td>
<td></td>
<td></td>
<td>• Low amplitude T waves</td>
<td>2. Nonspecific T wave abnormalities (minor)</td>
</tr>
<tr>
<td>QT=320</td>
<td></td>
<td></td>
<td></td>
<td>Note: The coarse a-fib activity in V1 somewhat resembles atrial flutter, but they are not equally spaced and have slightly varying morphology; this and the irregular RR intervals means A-fib)</td>
</tr>
<tr>
<td>Axis= -10</td>
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</tbody>
</table>
58 year old man with palpitations
Measurements:  
A= 150  V=120
PR= variable
QRS=80
QT=320
Axis=-30

Rhythm(s):  
Two choices:  
- Sinus tachycardia vs.
- Ectopic atrial tachycardia (more likely)

Conduction:  
2nd degree AV block (type I, Wenckebach)

Waveform:  
Normal P, QRS, ST-T

Interpretation:  
Abnormal ECG:
1. Rhythm and rate
2. 2nd degree AVB (type 1)
3. Borderline left axis deviation (LAD)

Note: repetitive group beating
32 year old man with idiopathic pulmonary hypertension
Ectopic atrial tachycardia

Normal AV, IV conduction

• Ectopic P wave morphology (can't be sinus, see arrows)
• Prominent anterior forces
• ST depression, T wave inversion in II, III, aVF, V1-6

Abnormal ECG:
1. Rhythm
2. Right axis deviation (RAD)
3. RAE (based on tall P in V1-2 even though not sinus rhythm)
4. RVH with strain pattern

These are not sinus P waves
55 year old man with palpitations
<table>
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<th>Waveform:</th>
<th>Interpretation:</th>
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</thead>
<tbody>
<tr>
<td>A= 160 V= 160</td>
<td>Supraventricular tachycardia (most likely AVNRT)</td>
<td>Normal IV</td>
<td>• ST depression I, II, aVL, V3-6</td>
<td>Abnormal ECG:</td>
</tr>
<tr>
<td>PR= none</td>
<td></td>
<td></td>
<td></td>
<td>1. Rhythm and rate; AVNRT is most likely diagnosis because there is a hint of retrograde P waves just after QRS in V1 (arrows)</td>
</tr>
<tr>
<td>QRS= 80</td>
<td></td>
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<td>2. ST depression suggestive of ischemia (kind of like a + ECG stress test)</td>
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<tr>
<td>QT= 300</td>
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<tr>
<td>Axis= +10</td>
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89 year old woman with intermittent palpitations; history of chronic HFpEF
F, Age 89

Measurements:

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<tr>
<td>A= ~65</td>
<td>Normal SA, AV, slightly wide QRS (IVCD)</td>
<td>Monophasic R in I and aVL</td>
<td>Abnormal ECG:</td>
</tr>
<tr>
<td>V=165 (SVT)</td>
<td>1. Three Sinus (*) with 2 PACs (blue arrows)</td>
<td>Poor R progression (V1-S)</td>
<td>1. Rhythm (PAC’s and AVNRT)</td>
</tr>
<tr>
<td>PR=200</td>
<td>2. Early PAC (green arrow) initiates AVNRT (AV nodal reentrant tachycardia)</td>
<td>LV voltage criteria +</td>
<td>2. LVH with ST-T abnormalities</td>
</tr>
<tr>
<td>QRS=110</td>
<td></td>
<td>ST-T changes of LV strain</td>
<td>3. Incomplete LBBB (often seen with severe LVH)</td>
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<tr>
<td>QT=360</td>
<td></td>
<td>Retrograde P waves during the SVT (red arrows)</td>
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<tr>
<td>Axis= -15</td>
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Abnormal ECG:
1. Rhythm (PAC’s and AVNRT)
2. LVH with ST-T abnormalities
3. Incomplete LBBB (often seen with severe LVH)
77 y.o. woman in E.R. with dyspnea and ↑ BNP
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation: |
---|---|---|---|---|
A\(\text{rate}\) varies \(V\approx150\) | Multifocal atrial tachycardia (MAT) | Normal AV, IV | • Multifocal atrial activity (note varying P wave morphology in V1, II, III)  
• 2 incomplete RBBB aberrancies (*), classic rsR'  
- not to be confused with PVC's. | Abnormal ECG:  
1. Rhythm (MAT) and rate |
PR\(\text{rate}\) varies | \(\text{QRS}=70\) | \(\text{QT}\approx320\) | \(\text{Axis}\approx+70\) |
**Measurements:**

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<td>A= varies</td>
<td>Multifocal atrial tachycardia (MAT)</td>
<td>Normal AV, IV</td>
<td>• Multifocal atrial activity conducted and nonconducted (*)</td>
<td></td>
</tr>
<tr>
<td>PR= varies</td>
<td></td>
<td></td>
<td>• Minor ST-T abnormalities</td>
<td>Abnormal ECG:</td>
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<td>QRS=70</td>
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<td></td>
<td>1. Rhythm (MAT) and rate</td>
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<tr>
<td>QT= ~320</td>
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<td>2. Nonspecific ST-T changes</td>
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November, 2002: 49 year old woman with altered mental status (found in Pioneer Park)
Atrial fibrillation with rapid HR response

- 'J' waves or Osborn waves (J waves are created when the epicardial cells are cooler than the endocardial cells; they are also seen in other electrical heart diseases, and in hypercalcemia)
- Low amplitude T waves

Abnormal ECG:
1. Rhythm and rate
2. Hypothermia
3. Nonspecific T abnormalities
4. Prolonged QT (seen in hypothermia)
JM: 56 y.o. man with palpitations; looks complicated, doesn’t it?
Measurements:

A=250  V= ~200
PR= varies
QRS=80, and 100
QT= ~240
Axis= -75

Rhythm(s):
- Atrial flutter (arrows)
- 4-beat V-tachycardia
- 1 PVC

Conduction:
- Both 2:1 and 3:2 AV conduction are seen with the atrial flutter

Waveform:
- rsR' alternating with qR in lead V1

Interpretation:
- Abnormal ECG:
  1. Rhythms and rate
  2. Incomplete RBBB

What initially looks complicated can be resolved by breaking up the rhythm into segments, looking carefully for atrial activity, atrial rate, and how each atrial event relates to the QRS's (arrows)
Measurements:

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<tbody>
<tr>
<td>A=250</td>
<td>V=125</td>
<td>PR=?</td>
<td>QRS=150</td>
<td>QT=360</td>
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Rhythm (s):

- Atrial flutter (arrows)

Note: every other flutter wave is hidden at end of the R’ of RBBB. Lead V1 is the only good lead in this ECG for identifying the rhythm.

Conduction:

- 2:1 AV conduction
- IVCD (RBBB)
- rsR’ in V1
- Late S (rightward force) in I, aVL, V5-6

Waveform:

- Abnormal ECG:
  1. Rhythm and rate
  2. RBBB